



Power Grid Research Themes and Facilities at the University of Pittsburgh Related to the GTC Mission

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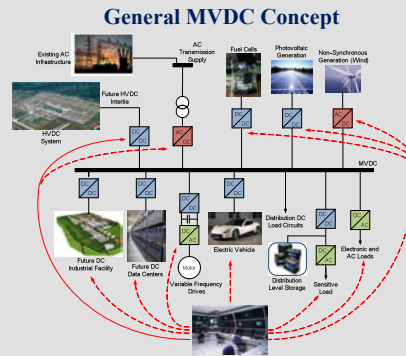
Medium Voltage DC Microgrid: Theory to Application

Fundamental Requirements of Microgrids

- Capability of Operating in Islanding and/or Grid Connected Modes with High Stability.
- Mode switching with minimum load disruption and shedding during transitions.
- After a transition, stabilize in a certain amount of time.

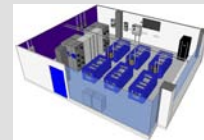
Research Challenges of Microgrids

- Operational inverter improvements (harsh environment design, robust operation during fault conditions, volume and weight reduction).
- Integrated storage inverter & direct medium voltage inverter design.
- DC microgrid subsystems.
- Protection is also one of the most important challenges facing the deployment of microgrids.



Existing and Planned Facilities for Power Grid Research

Electric Power Systems Laboratory



Lab Facility
Ratings: 480 V, 30 kW



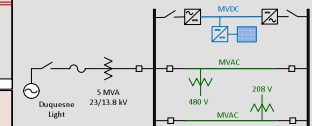
Custom Designed Bench

PV on Engineering School
Rooftop to Feed into
Eaton-Sponsored Lab

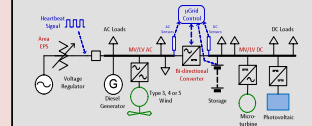


Electric Power Technologies Laboratory (Under Conceptual Development)

Ratings: 15 kV-AC, 1 kV-DC,
1MVA Capacity



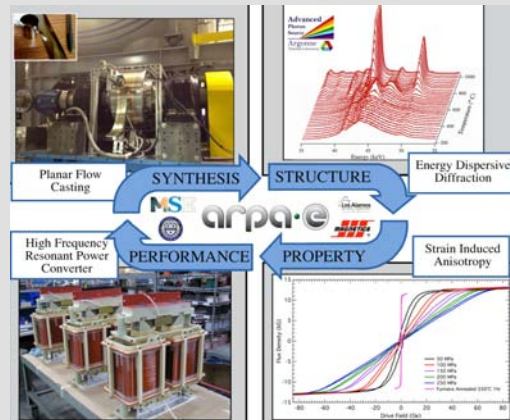
Conceptual One-Line Diagram



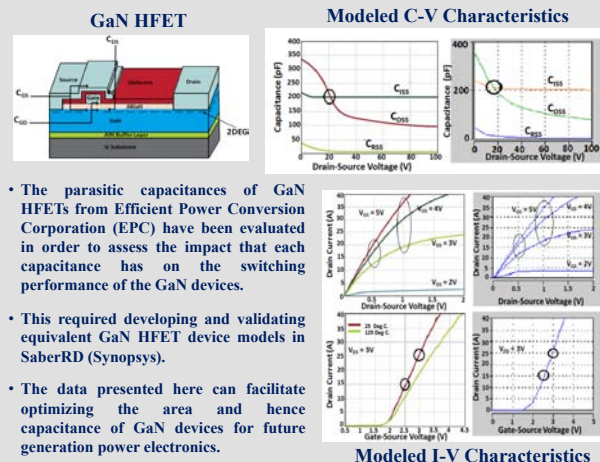
Example Feeder Configuration



Magnetics Design for High Power Applications

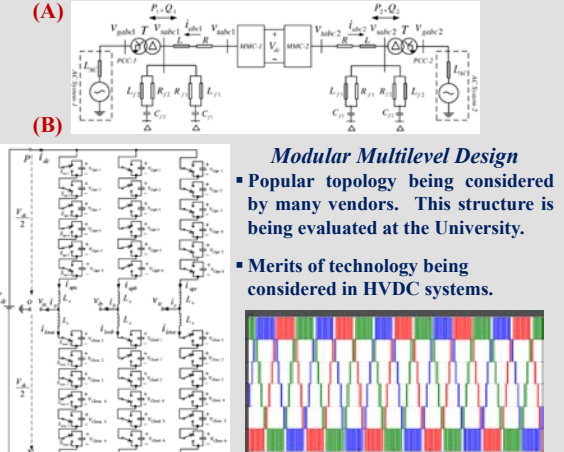


Power Semiconductor Device Modeling



- The parasitic capacitances of GaN HFETs from Efficient Power Conversion Corporation (EPC) have been evaluated in order to assess the impact that each capacitance has on the switching performance of the GaN devices.
- This required developing and validating equivalent GaN HFET device models in SaberRD (Synopsys).
- The data presented here can facilitate optimizing the area and hence capacitance of GaN devices for future generation power electronics.

High Voltage DC Modeling & Protection



Modular Multilevel Design

- Popular topology being considered by many vendors. This structure is being evaluated at the University.
- Merits of technology being considered in HVDC systems.